

What is claimed is:

1. A method for removing a protective group from a synthesis intermediate comprising the steps of:
 - a) forming a surface comprising
 - i) a photosensitive compound or group, said photosensitive compound or group producing a catalyst when irradiated, and
 - ii) an autocatalytic compound or group, said autocatalytic compound or group generating a protecting group removing product when said autocatalytic compound is activated by said catalyst, and
 - iii) a compound capable of introducing latency, and
 - b) irradiating at least a part of said surface to remove said protecting group.
2. The method of claim 1 wherein forming a surface further comprises a catalyst scavenger, said catalyst scavenger being capable of interacting with said catalyst such that some of said catalyst produced in cannot interact with said autocatalytic compound or group.
3. The method recited in claim 2 wherein said catalyst scavenger is an acid scavenger.
4. The method recited in claim 1 wherein said synthesis intermediate is a nucleotide.
5. The method recited in claim 1 wherein said synthesis intermediate is a polynucleotide.
6. The method recited in claim 1 wherein said synthesis intermediate is an amino acid.
7. The method recited in claim 1 wherein said synthesis intermediate is a polypeptide.

8. The method recited in claim 1 wherein said removable protecting group is an acid removable group.
9. A method for synthesizing polymers of diverse sequences comprising the steps of:
- a) forming a surface comprising a protective group;
 - b) coating said surface with a layer comprising:
 - i) a photosensitive compound or group, said photosensitive compound or group producing a catalyst when irradiated, and
 - ii) an autocatalytic compound or group, said autocatalytic compound or group generating a protecting group removing product when said autocatalytic compound is activated by said catalyst, and
 - c) irradiating at least a part of said surface to remove said protecting group;
 - d) removing said layer;
 - e) contacting the surface with a first monomer;
 - f) depositing on the surface a layer as in b);
 - g) irradiating at least a part of said surface to remove said protecting group;
 - h) removing said layer; and
 - i) contacting the surface with a second monomer.
10. The method of claim 9 wherein said layer further comprises a catalyst scavenger, said catalyst scavenger being capable of interacting with said catalyst such that some of said catalyst produced in cannot interact with said autocatalytic compound or group.
11. The method recited in claim 10 wherein said catalyst scavenger is an acid scavenger.
12. The method recited in claim 9 wherein said synthesis intermediate is a nucleotide.

13. The method recited in claim 9 wherein said synthesis intermediate is a polynucleotide.
14. The method recited in claim 9 wherein said synthesis intermediate is an amino acid.
15. The method recited in claim 9 wherein said synthesis intermediate is a polypeptide.
16. The method recited in claim 9 wherein said removable protecting group is an acid removable group.
17. An apparatus for solid phase chemical synthesis comprising a substrate comprising:
- i) a synthesis intermediate comprising a removable protecting group;
 - ii) a photosensitive compound or group, said photosensitive compound or group producing a catalyst when irradiated;
 - iii) an autocatalytic compound or group, said autocatalytic compound or group generating a protecting group removing product when said autocatalytic compound is activated by said catalyst; and
18. The method of claim 17 wherein forming a surface further comprises a catalyst scavenger, said catalyst scavenger being capable of interacting with said catalyst such that some of said catalyst produced in cannot interact with said autocatalytic compound or group.
19. The method recited in claim 18 wherein said catalyst scavenger is an acid scavenger.

20. The apparatus recited in claim 17 wherein said synthesis intermediate is a nucleotide.
21. The apparatus recited in claim 17 wherein said synthesis intermediate is a polynucleotide.
22. The apparatus recited in claim 17 wherein said synthesis intermediate is an amino acid.
23. The apparatus recited in claim 17 wherein said synthesis intermediate is a polypeptide.
24. The apparatus recited in claim 17 wherein said removable protecting group is an acid removable group.
25. The apparatus recited in claim 17 wherein said catalyst scavenger is an acid scavenger.
26. A method for hybridizing nucleic acid comprising the steps of:
- a) forming a surface comprising a protective group;
 - b) coating said surface with a layer comprising:
 - i) a photosensitive compound or group, said photosensitive compound or group producing a catalyst when irradiated,
 - ii) an autocatalytic compound or group, said autocatalytic compound or group generating a protecting group removing product when said autocatalytic compound is activated by said catalyst; and
 - c) irradiating at least a part of said surface to remove said protecting group;
 - d) removing said layer;
 - e) contacting the surface with a first monomer;
 - f) depositing a layer as in b);

- g) irradiating at least another part of said surface to remove said protecting group;
- h) removing said layer;
- i) contacting the surface with a second monomer;
- j) repeating steps b to h to synthesize polynucleotide arrays of desired length; and
- k) hybridizing a target nucleic acid to said polynucleotide arrays.
27. The method of claim 26 wherein said layer further comprises a catalyst scavenger, said catalyst scavenger being capable of interacting with said catalyst such that some of said catalyst produced in cannot interact with said autocatalytic compound or group.
28. The method recited in claim 27 wherein said catalyst scavenger is an acid scavenger.
29. The method recited in claim 26 wherein said synthesis intermediate is a nucleotide.
30. The method recited in claim 26 wherein said synthesis intermediate is a polynucleotide.
31. The method recited in claim 26 wherein said removable protecting group is an acid removable group.
32. The method recited in claim 26 wherein said catalyst scavenger is an acid scavenger.
33. A method for synthesizing a polymer array on a substrate comprising the steps of:

- a) providing a layer on the surface of the substrate having one or more synthesis intermediates bound thereon, a catalyst system, and a catalyst scavenger, the synthesis intermediates having a reactive group protected from reaction by a protective group;
- b) irradiating the surface of the substrate with radiation of certain wavelength;
- c) initiating a catalytic reaction to remove the protective group from the synthesis intermediates to produce unprotected reactive groups;
- d) removing said layer;
- e) reacting a subsequently added synthesis intermediate with the unprotected reactive group, the subsequently added synthesis intermediate having a reactive group protected from reaction by a protective group;
- f) repeating steps a through e, or not, until a desired polymer sequence is obtained.

34. A method for hybridizing nucleic acid comprising the steps of:

- a) forming a surface comprising a protective group;
- b) coating said surface with a layer comprising:
- i) a photosensitive compound or group, said photosensitive compound or group producing a catalyst when irradiated,
 - ii) an autocatalytic compound or group, said autocatalytic compound or group generating a protecting group removing product when said autocatalytic compound is activated by said catalyst, and
- c) irradiating at least a part of said surface to remove said protecting group;
- d) removing said layer;
- e) contacting the surface with a first monomer;
- f) depositing a layer as in a);
- g) irradiating at least another part of said surface to remove said protecting group;
- h) removing said layer;
- i) contacting the surface with a second monomer;

- j) repeating steps a to h to synthesize polynucleotide arrays of desired length; and
- k) hybridizing a target nucleic acid to said polynucleotide arrays.

5 35. The method of claim 34 wherein forming a surface further comprises a catalyst scavenger, said catalyst scavenger being capable of interacting with said catalyst such that some of said catalyst produced in cannot interact with said autocatalytic compound or group.

10 36. The method of claim 35 where in said catalyst scavenger is an acid scavenger.

37. A method for removing a photosensitive protective group from a synthesis intermediate comprising the steps of:

- 15
- a) forming a surface comprising a photosensitive compound or group;
 - b) coating said surface with a substance comprising a photobleachable compound or group; and
 - c) irradiating at least a part of said surface to:
 - i) bleach said photobleachable compound; and
 - 20 ii) remove said protective group.

38. A method for removing a photosensitive protective group from a synthesis intermediate comprising the steps of:

- 25
- a) providing a first surface comprising a photosensitive compound or group;
 - b) providing a second surface comprising a photobleachable compound or group;
 - d) providing a source of radiation;
 - e) placing said second surface between said first surface and said source of radiation;
 - 30 f) irradiating at least a part of said second surface to bleach said photobleachable compound on said second surface thereby allowing

radiation to reach and thus irradiate said first surface to remove said protective group.

39. The method of claim 38 wherein said second surface is a mask or a glass blank.

40. The methods of claims 37 and 38 wherein said synthesis intermediate is a nucleotide.

41. The methods of claim 37 and 38 wherein said synthesis intermediate is a polynucleotide.

42. The methods of claims 37 and 38 wherein said synthesis intermediate is an amino acid.

43. The methods of claims 37 and 38 wherein said synthesis intermediate is a polypeptide.

44. The methods of claims 37 and 38 wherein said photobleachable compound is a photobleachable dye.

45. The method of claim 44 wherein said photobleachable dye is pyrylium dye or diazonium dye.

46. A method for synthesizing polymers of diverse sequences comprising the steps of:

- a) forming a surface comprising a photosensitive protecting group
- b) coating said surface with a substance comprising a photobleachable compound or group
- c) irradiating at least a part of said surface to:
 - i) bleach said photobleachable compound; and

- ii) remove said protective group;
- d) removing said substance from said surface;
- e) contacting the surface with a first monomer;
- f) recoating said surface with a substance comprising a photobleachable compound or group;
- g) irradiating at least another part of said surface to:
 - i) bleach said photobleachable compound; and
 - ii) remove said protective group;
- h) removing said substance; and
- i) contacting the surface with a second monomer.

47. A method for synthesizing polymers of diverse sequences comprising the steps of:

- a) providing a first surface comprising a photosensitive compound or group;
- b) providing a second surface comprising a photobleachable compound;
- c) providing a source of radiation;
- d) placing said second surface between said first surface and said source of radiation;
- e) irradiating at least a part of said second surface to bleach said photobleachable compound on said second surface thereby allowing radiation to reach and thus irradiate said first surface to remove said protective group;
- f) contacting the surface with a first monomer;
- g) stripping and recoating said second surface or providing a third surface comprising a photobleachable compound;
- h) placing said second or third surface between said first surface and said source of radiation;
- i) irradiating at least a part of said second or third surface to bleach said photobleachable compound on said second or third surface thereby allowing radiation to reach and thus irradiate said first surface to remove said protective group;

j) contacting the first surface with a second monomer.

48. The method of claim 47 wherein said second surface is a glass blank.

5 49. The method of claim 47 wherein said second surface is a mask.

50. The methods of claims 46 and 47 wherein said synthesis intermediate is a nucleotide.

10 51. The methods of claim 46 and 47 wherein said synthesis intermediate is a polynucleotide.

15 52. The methods of claims 46 and 47 wherein said synthesis intermediate is an amino acid.

53. The methods of claims 46 and 47 wherein said synthesis intermediate is a polypeptide.

20 54. The methods of claims 46 and 47 wherein said photobleachable compound is a photobleachable dye.

55. The method of claim 54 wherein said photobleachable dye is pyrylium dye or diazonium dye.

25 56. A method for synthesizing a polymer array on a substrate comprising the steps of:

- 30 a) forming a surface having one or more synthesis intermediates bound thereon, the synthesis groups having a reactive group protected from reaction by a photosensitive protecting group;
- b) coating said surface with a substance comprising a photobleachable compound or group

- 5 c) irradiating at least a part of said surface to:
- i) bleach said photobleachable compound; and
 - ii) remove said protective group;
- d) removing said substance from said surface;
- 5 e) reacting a subsequently added synthesis intermediate with the unprotected reactive group, the subsequently added synthesis intermediate having a reactive group protected from reaction by a protective group;
- f) recoating said surface with a substance comprising a photobleachable compound or group if another synthesis intermediate is to be added; and
- 10 g) repeating steps b) through f) or not, until a desired polymer sequence is obtained.

57. A method for synthesizing a polymer array on a substrate comprising the steps of:

- 15 a) forming a first surface having one or more synthesis intermediates bound thereon, the synthesis groups having a reactive group protected from reaction by a photosensitive protecting group;
- b) providing a second surface comprising a photobleachable compound;
- c) providing a source of radiation;
- 20 d) placing said second surface between said first surface and said source of radiation;
- e) irradiating at least a part of said second surface to bleach said photobleachable compound on said second surface thereby allowing radiation to reach and thus irradiate said first surface to remove said protective group;
- 25 f) reacting a subsequently added synthesis intermediate with the unprotected reactive group, the subsequently added synthesis intermediate having a reactive group protected from reaction by a protective group;
- 30 g) stripping and recoating said second surface or providing a third surface comprising a photobleachable compound, if another synthesis intermediate is to be added

h) repeating steps b) through h) or not, until a desired polymer sequence is obtained.

58. The method of claim 57 wherein said second surface is a glass blank.

59. The method of claim 57 wherein said second surface is a mask.

60. The methods of claims 56 and 57 wherein said synthesis intermediate is a nucleotide.

61. The methods of claims 56 and 57 wherein said synthesis intermediate is a polynucleotide.

62. The methods of claims 56 and 57 wherein said synthesis intermediate is an amino acid.

63. The methods of claims 56 and 57 wherein said synthesis intermediate is a polypeptide.

64. The methods of claims 56 and 57 wherein said photobleachable compound is a photobleachable dye.

65. The method of claim 64 wherein said photobleachable dye is pyrylium dye or diazonium dye.

66. A method for removing a photosensitive protective group from a synthesis intermediate comprising the steps of:

- a) forming a surface comprising a photosensitive compound or group;
- b) coating said surface with a substance comprising a photobleachable compound or group and a sensitizer; and
- c) irradiating at least a part of said surface to:

- i) bleach said photobleachable compound; and
- ii) remove said protective group.

67. A method for removing a photosensitive protective group from a synthesis intermediate comprising the steps of:

- a) providing a first surface comprising a photosensitive compound or group;
- b) providing a second surface comprising a photobleachable compound or group and a sensitizer;
- d) providing a source of radiation;
- e) placing said second surface between said first surface and said source of radiation;
- f) irradiating at least a part of said second surface to bleach said photobleachable compound on said second surface thereby allowing radiation to reach and thus irradiate said first surface to remove said protective group.

68. A method for removing a protective group from a synthesis intermediate comprising the steps of:

- a) forming a surface comprising:
 - i) a CEM to modulate light hitting the surface; and
 - ii) a photosensitive compound or group, said photosensitive compound or group producing a catalyst when irradiated; and
 - iii) an autocatalytic compound or group, said autocatalytic compound or group generating a protecting group removing product when said autocatalytic compound is activated by said catalyst; and
- b) irradiating at least a part of said surface to remove said protecting group.

69. The method of claim 68 wherein the surface of step (a) further comprises a catalyst scavenger, said catalyst scavenger being capable of interacting with said catalyst such that some of said catalyst produced in i) cannot interact with said autocatalytic compound or group.

70. A method for removing a protective group from a synthesis intermediate comprising the steps of:
- a) forming a surface comprising:
- i) a CEM that has a non linear response to light and will modulate light hitting the surface by absorbing light and will also generate acid to remove acid labile protecting groups; and a photosensitive compound or group, said photosensitive compound or group producing a catalyst when irradiated, and
- ii) an autocatalytic compound or group, said autocatalytic compound or group generating a protecting group removing product when said autocatalytic compound is activated by said catalyst; and
- b) irradiating at least a part of said surface to remove said protecting group.
71. The method of claim 70 wherein the surface of step (a) further comprises a catalyst scavenger, said catalyst scavenger being capable of interacting with said catalyst such that some of said catalyst produced in i) cannot interact with said autocatalytic compound or group.
72. The method recited in claim 71 wherein said catalyst scavenger is an acid scavenger.
73. The method recited in claim 70 wherein said synthesis intermediate is a nucleotide.
74. The method re cited in claim 70 wherein said synthesis intermediate is a polynucleotide.
75. The method recited in claim 70 wherein said synthesis intermediate is an amino acid.

76. The method recited in claim 70 wherein said synthesis intermediate is a polypeptide.
77. The method recited in claim 70 wherein said removable protecting group is an acid removable group.
78. A method for removing a protective group from a synthesis intermediate comprising the steps of:
- a) forming a surface comprising
 - i) a photosensitive compound or group, said photosensitive compound or group generating a protecting group removing product upon irradiation
 - b) irradiating at least a part of said surface to remove said protecting group.
79. The method of claim 78 wherein forming a surface further comprises a catalyst scavenger, said catalyst scavenger being capable of interacting with said catalyst such that some of said catalyst produced in cannot interact with said autocatalytic compound or group.